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Kawamura et al.

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(54) **CRIMP TERMINAL, CONNECTION STRUCTURAL BODY AND CONNECTOR**

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(51) **Int. Cl.**

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H01R 4/20	(2006.01)
H01R 13/52	(2006.01)
H01R 4/62	(2006.01)

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CPC .. ***H01R 4/18*** (2013.01); ***H01R 4/10*** (2013.01); ***H01R 4/206*** (2013.01); ***H01R 13/52*** (2013.01); *H01R 4/62* (2013.01)

(58) **Field of Classification Search**

USPC .... 439/878, 741, 430, 442, 203, 585; 174/84 C

See application file for complete search history.

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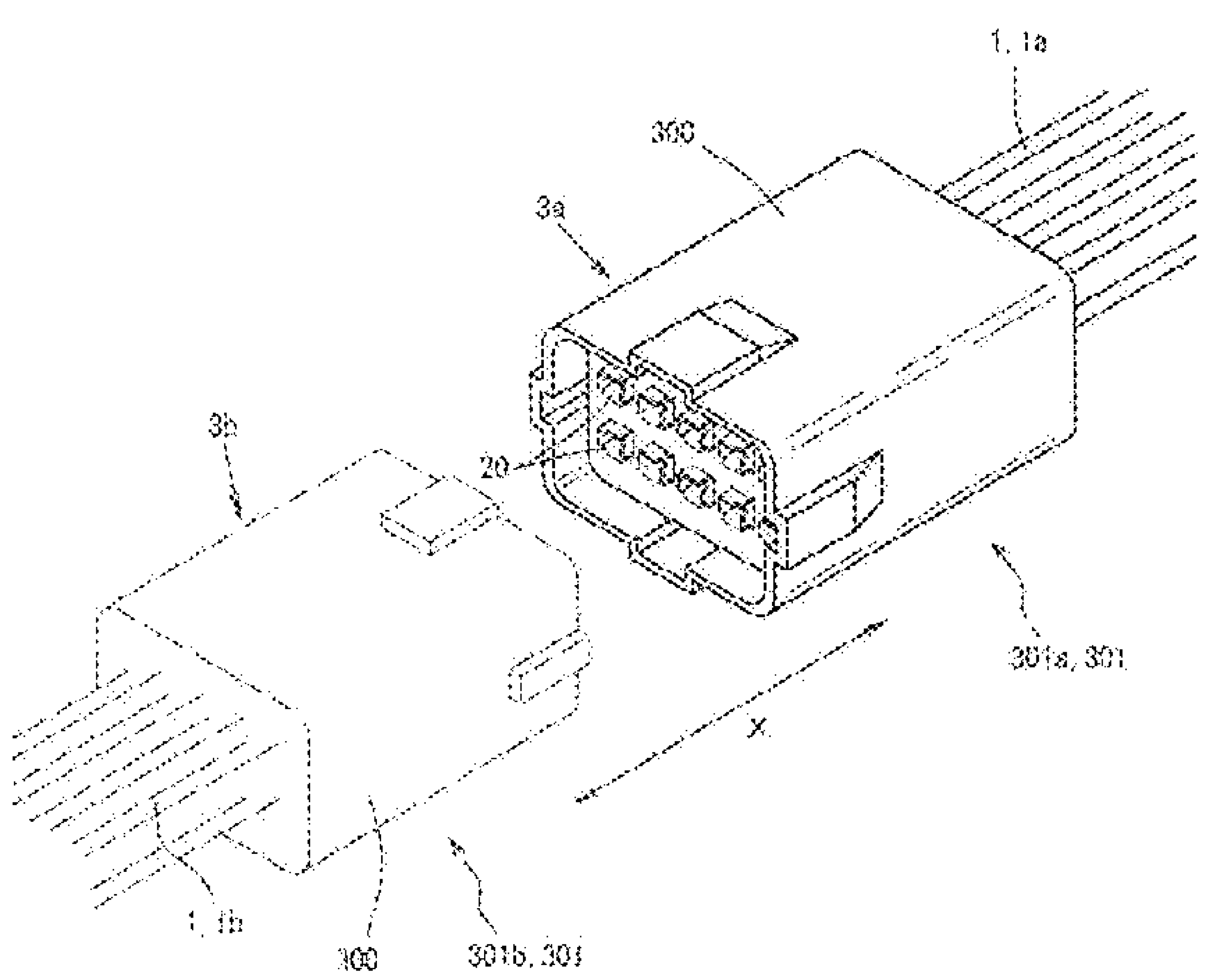
(57) **ABSTRACT**

The present invention has an object of providing a crimp terminal capable of maintaining a high level of water-blocking performance for a long time in a state of being pressure-bonded to an insulated wire, a connection structural body including the same, and a connector including such a connection structural body.

13 Claims, 6 Drawing Sheets



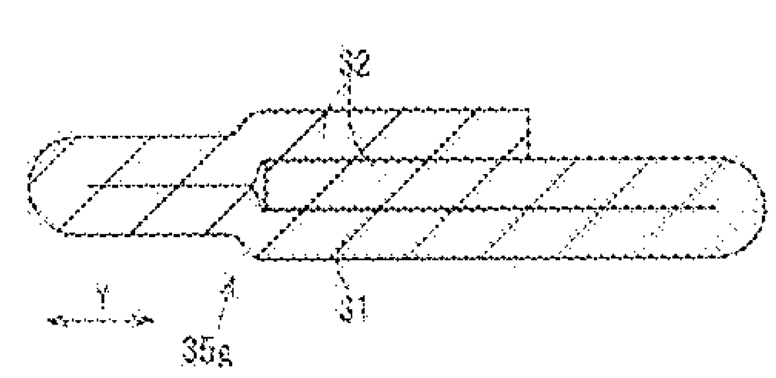


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FIG. 1A

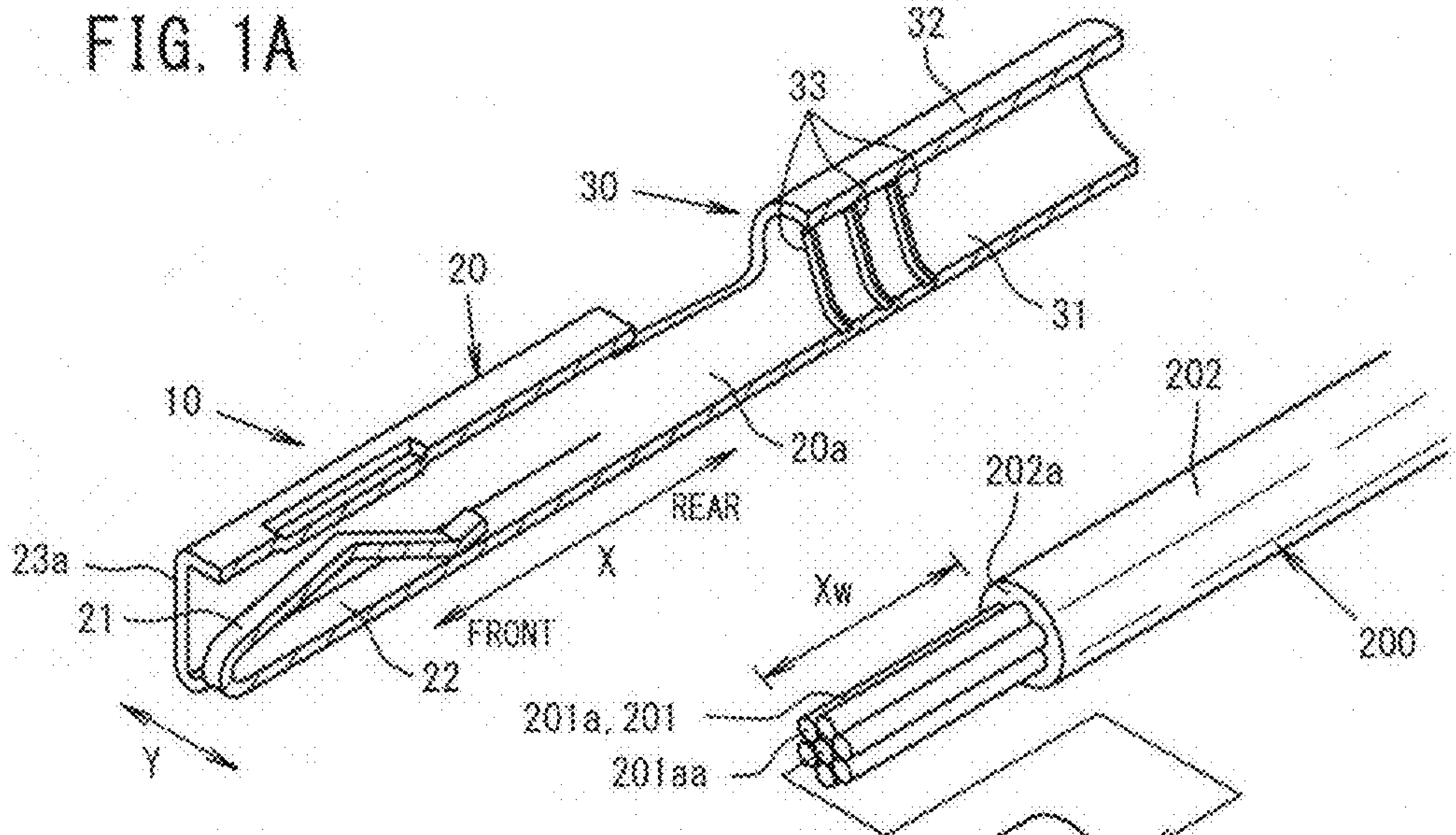


FIG. 1B

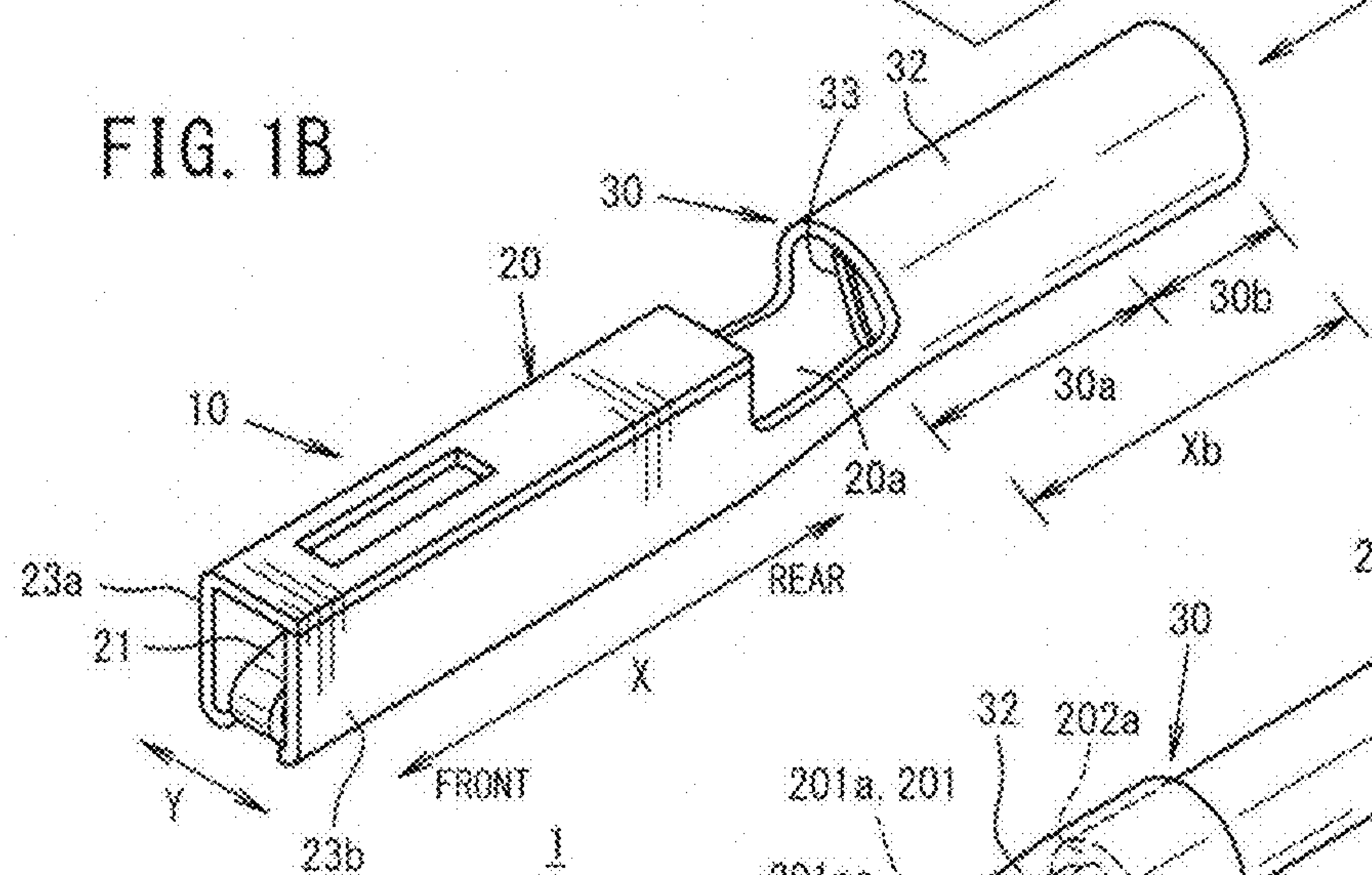


FIG. 1C

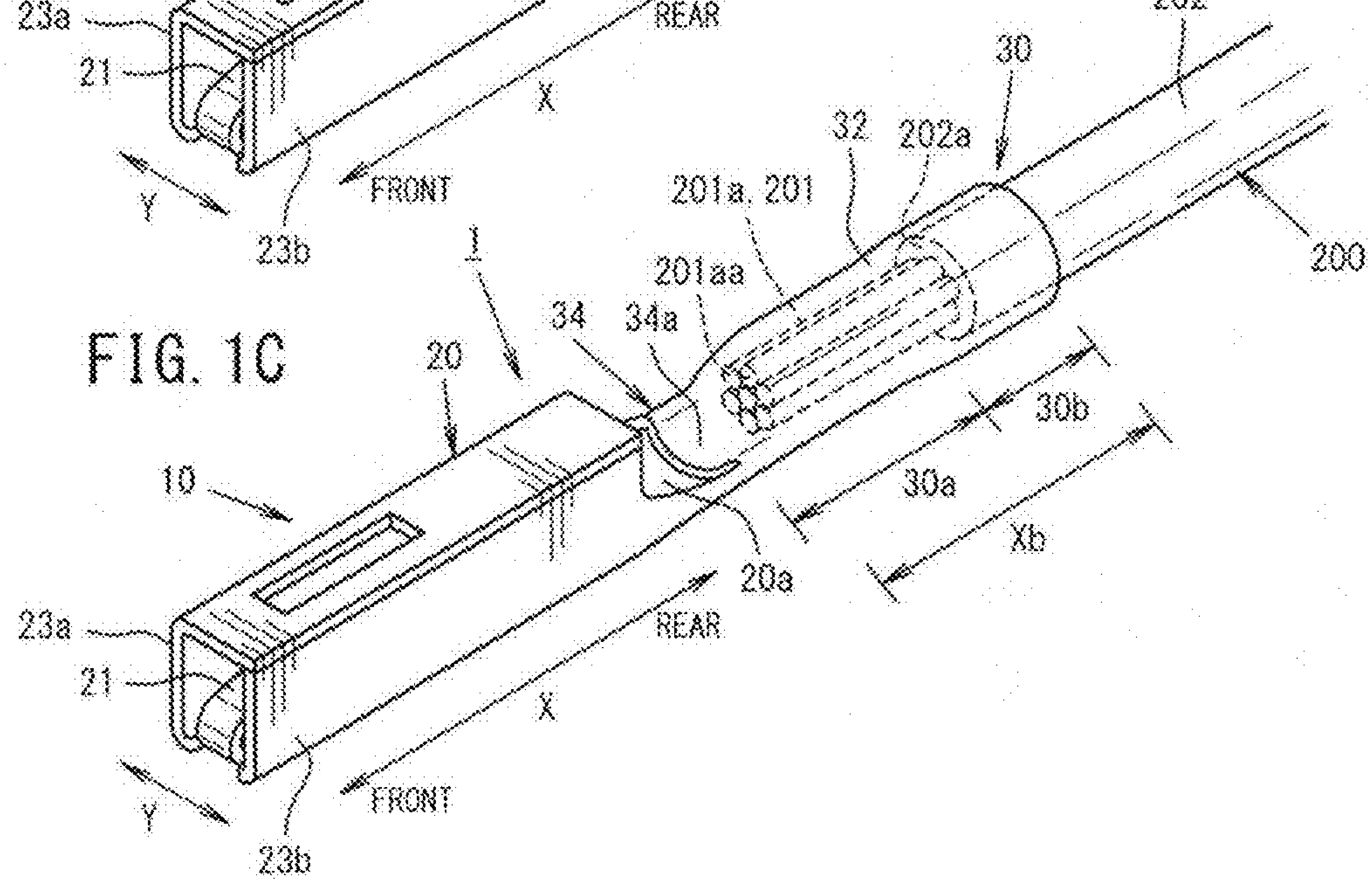


FIG. 2A

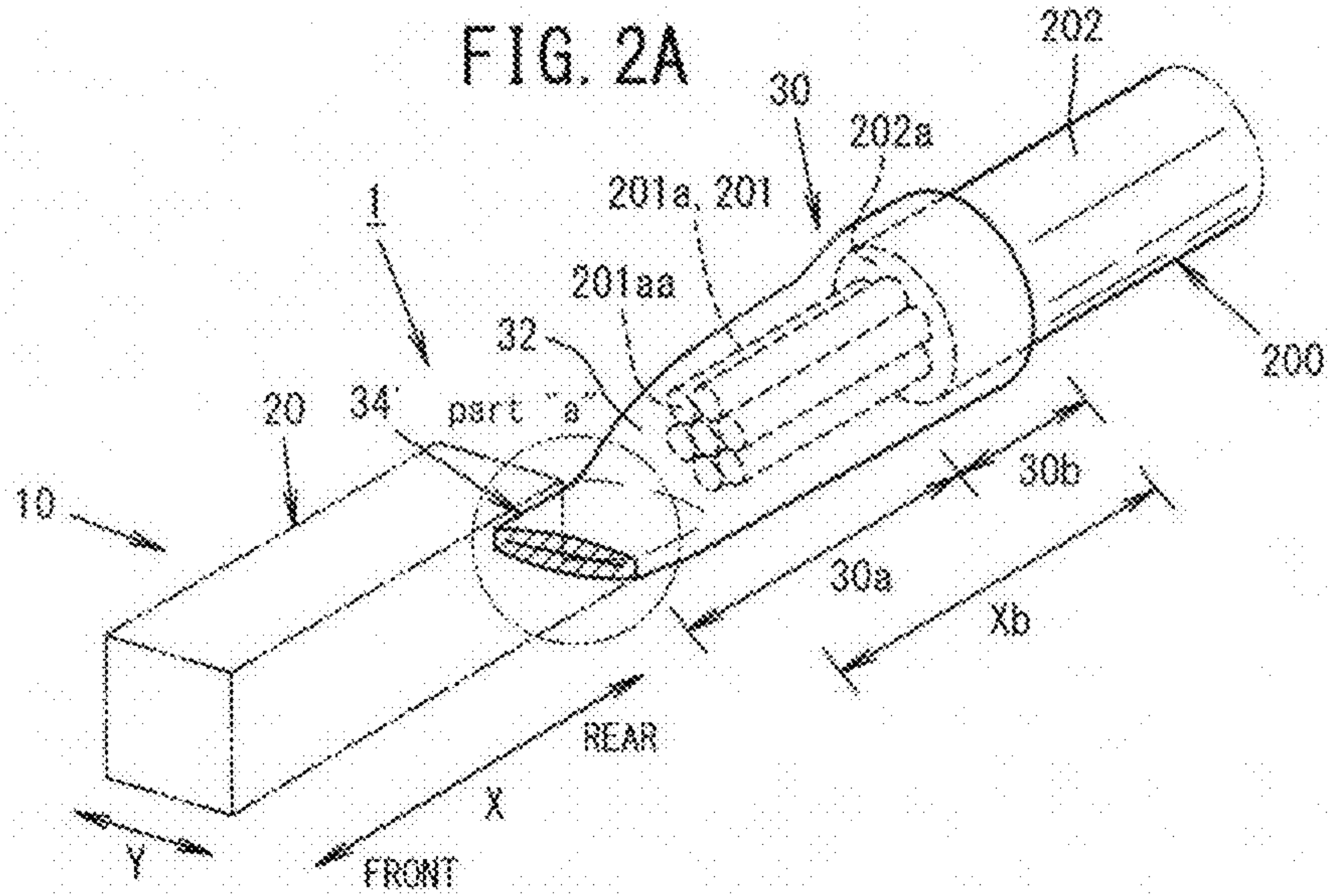


FIG. 2B

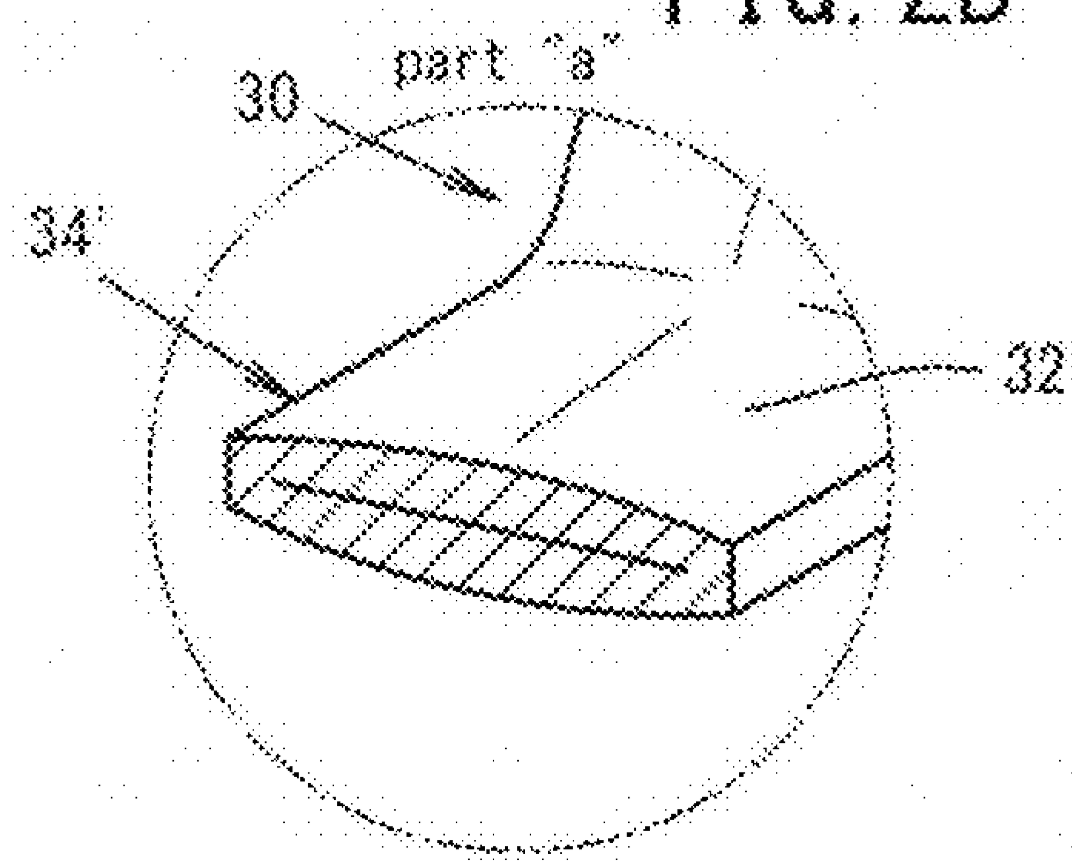


FIG. 2C

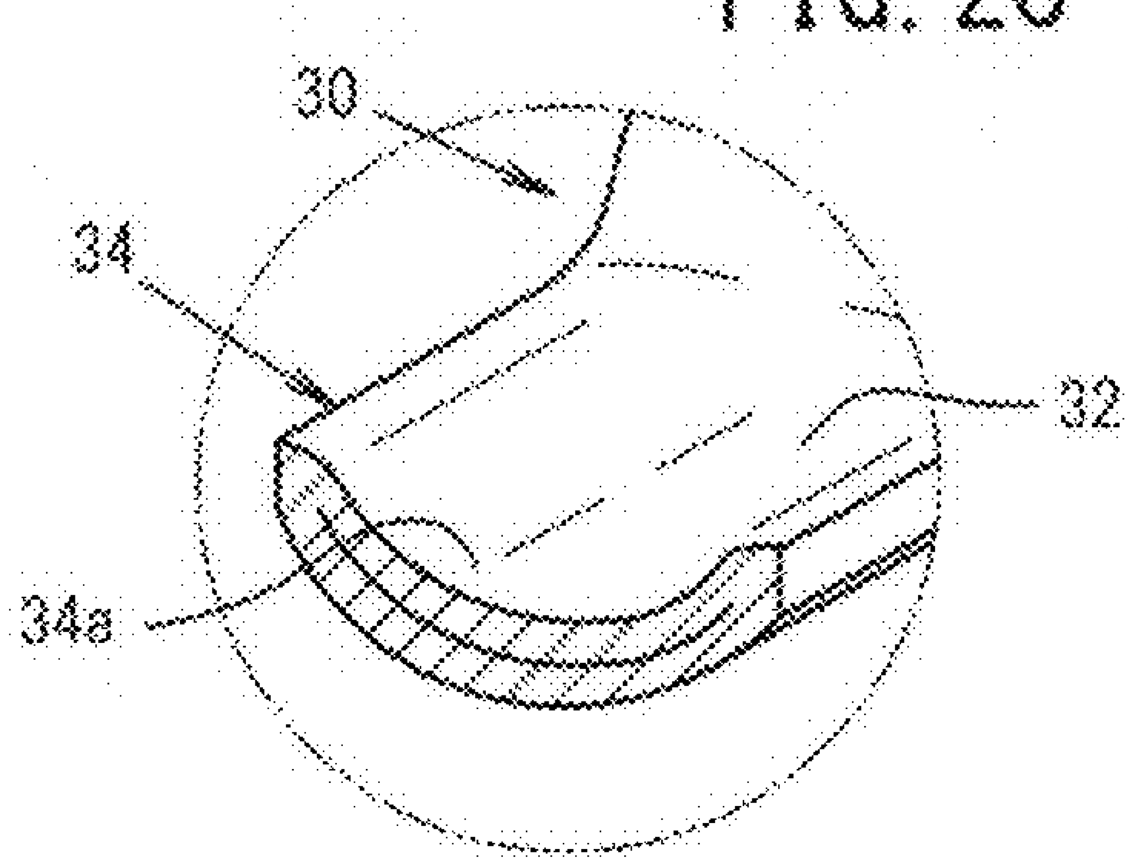


FIG. 3

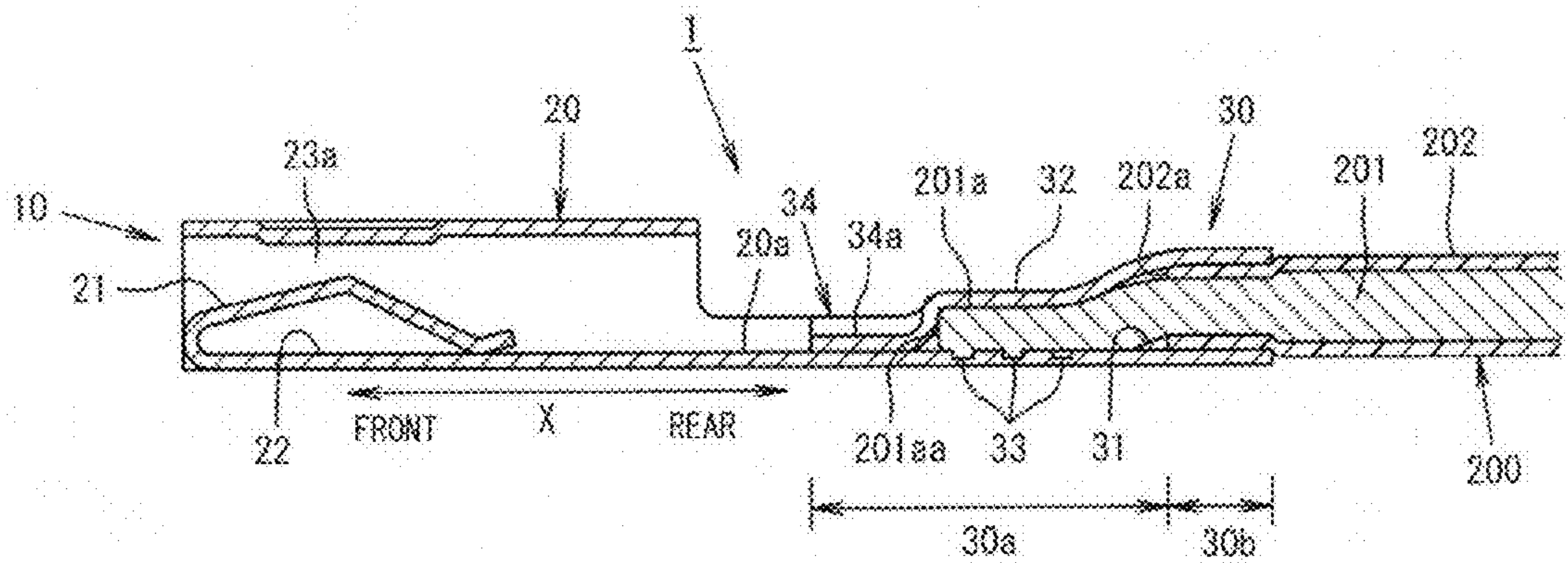
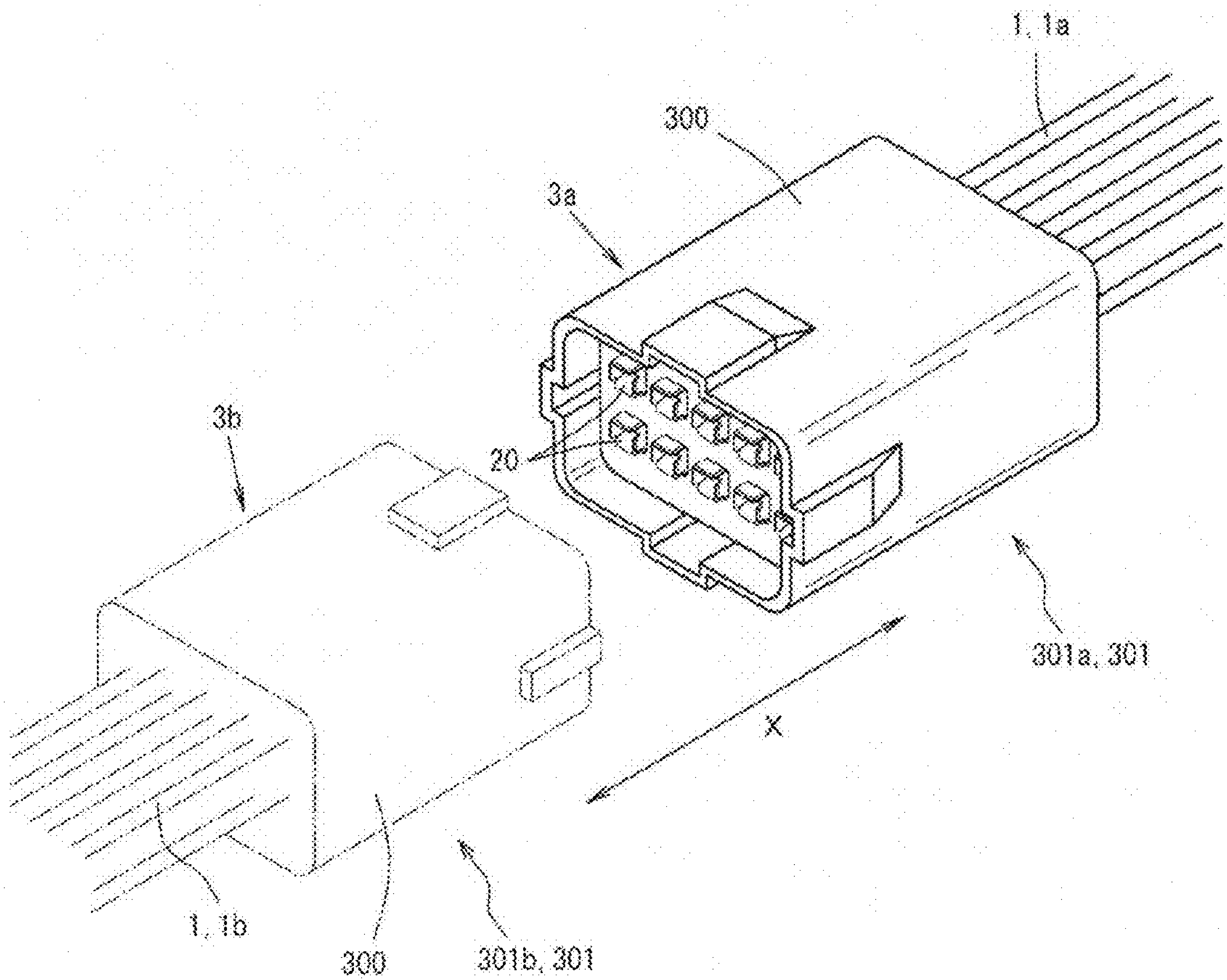

1
10
20
23a
21
22
FRONT
X
REAR
20a
34
34a
201a
32
202a
30
201
202
201aa
33
31
200
30a
30b

FIG. 4



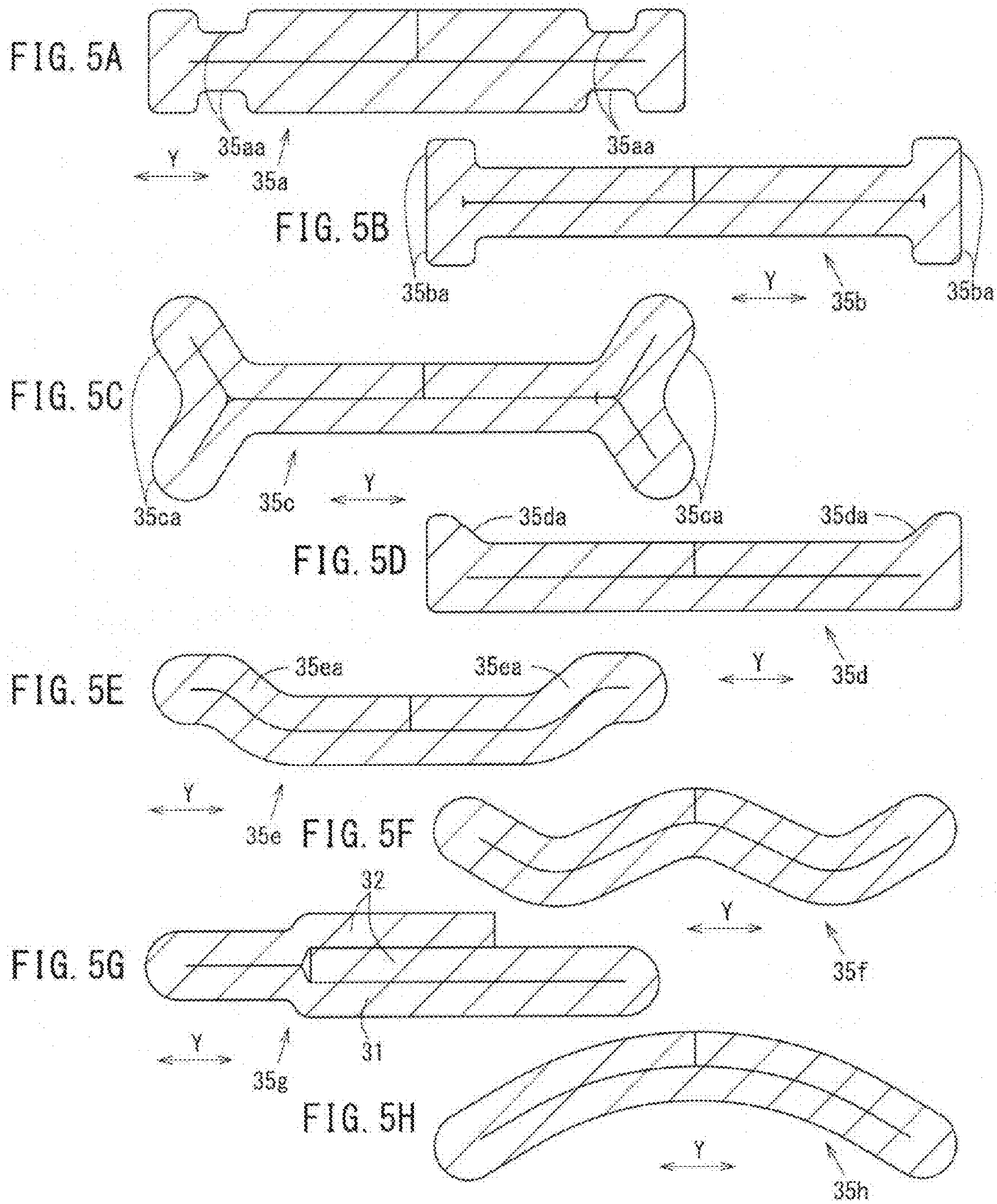


FIG. 5A
35aa
35aa
35a
Y
FIG. 5B
35ba
35b
35ba
Y
FIG. 5C
35ca
35c
35ca
Y
FIG. 5D
35da
35da
35d
Y
FIG. 5E
35ea
35ea
35e
Y
FIG. 5F
35f
Y
FIG. 5G
32
31
35g
Y
FIG. 5H
35h
Y

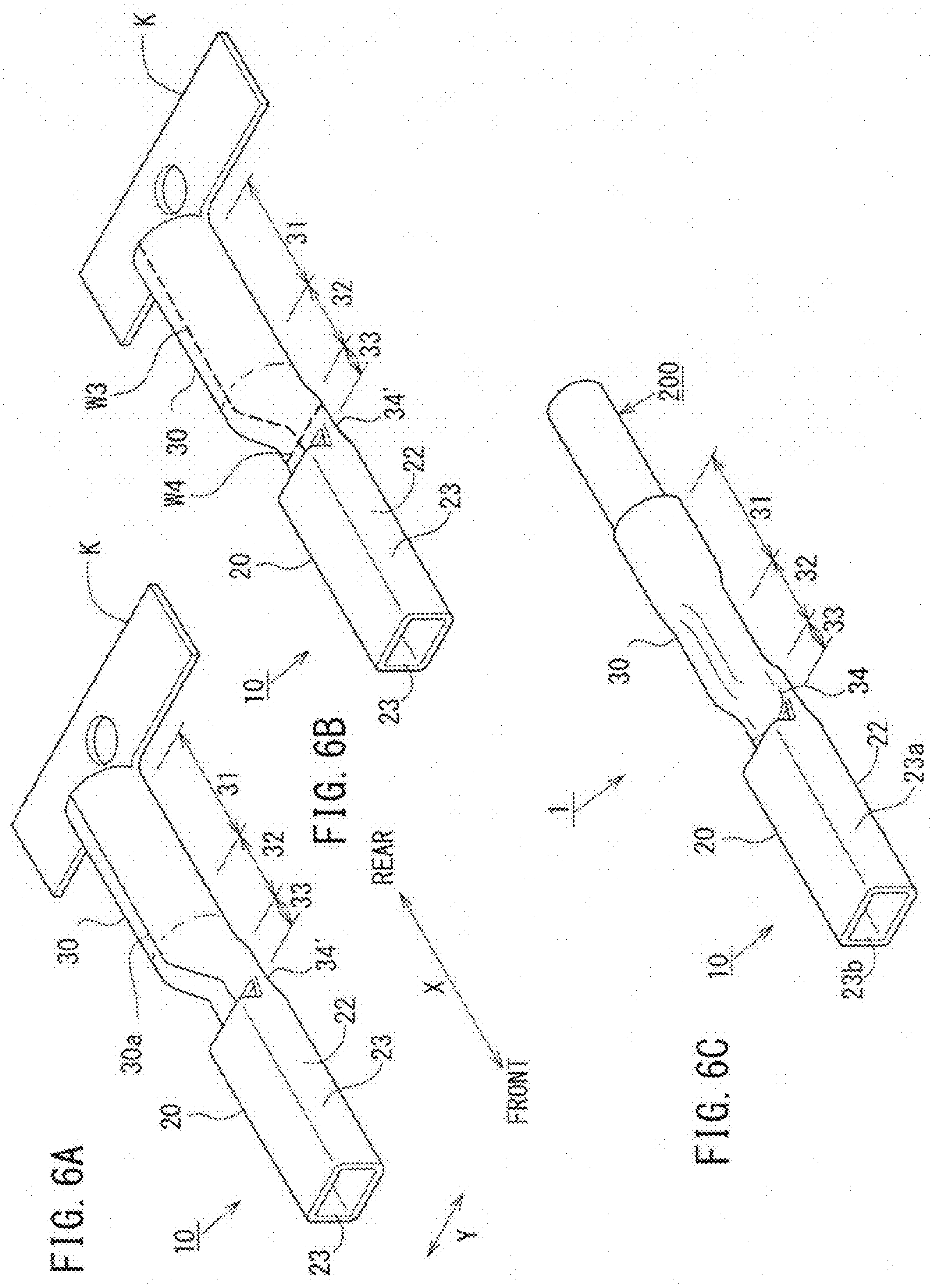


FIG. 6A

FIG. 6B

FIG. 6C

CRIMP TERMINAL, CONNECTION STRUCTURAL BODY AND CONNECTOR

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation application of PCT International Application No. PCT/JP2013/069691 filed Jul. 19, 2013, which claims priority to Japanese Application No. 2012-162076 filed Jul. 20, 2012, both of which are herein incorporated by reference in their entirety for all purposes.

TECHNICAL FIELD

The present invention relates to a crimp terminal attachable to a connector or the like provided for, for example, connection of a wire harness for an automobile, a connection structural body including the same, and a connector including such a connection structural body.

BACKGROUND ART

A crimp terminal includes a pressure-bonding section that electrically connects a conductor of an insulated wire thereto. More specifically, the insulated wire is inserted into the pressure-bonding section, and then the pressure-bonding section is caulked to be pressure-bonded to the conductor. Thus, the insulated wire is connected to the pressure-bonding section.

Such a crimp terminal is used for, for example, a wire harness that connects electric parts of an automobile to each other.

As automobiles are improved in safety, comfort and convenience, wire harnesses are improved in functionality and performance and thus are increased in diameter and weight. In such a situation, insulated wires, which are considered to occupy about 60% of the total weight of wire harnesses, now include conductors formed of aluminum or an aluminum alloy instead of copper.

By contrast, crimp terminals are formed of copper. Where the conductor is formed of aluminum instead of copper, the pressure-bonding section of the crimp terminal is subjected to dissimilar metal contact. More specifically, when contacting water or moisture, the pressure-bonding section is easily corroded. This is referred to as "galvanic corrosion".

In order to prevent galvanic contact from occurring even in the case where the conductor is formed of aluminum, the technology disclosed in, for example, Patent Document 1 has been developed. According to this technology, the contact interface between the aluminum conductor and the crimp terminal is isolated from outside with a resin material so that water is blocked. According to such a corrosion-resisting structure disclosed in Patent Document 1, the insulated wire is connected to the crimp terminal, and then a mold portion formed of a resin is formed in a connection part where the crimp terminal and the insulated wire are connected to each other.

However, such a corrosion-resisting structure has the following problem. The connection part where the crimp terminal, formed of a metal material, and the insulated wire, which is formed of a resin, are connected to each other is molded with a resin material. Therefore, the resin material used for the mold portion is deteriorated after being used for a long time and the water-blocking performance thereof is declined.

CITATION LIST

Patent Literature

Patent Document 1: Japanese Laid-Open Patent Publication No. 2012-3856

SUMMARY OF INVENTION

Technical Problem

The present invention has an object of providing a crimp terminal capable of maintaining a high level of water-blocking performance for a long time in the state of being pressure-bonded to an insulated wire, a connection structural body including the same, and a connector including such a connection structural body.

Solution to Problem

The present invention is directed to a crimp terminal, including a pressure-bonding section that allows at least a conductor tip of a conductor of an insulated wire to be connected thereto by pressure-bonding, the conductor being covered with an insulating cover, and the conductor tip being exposed as a result of peeling off the insulating cover on a tip side, wherein the pressure-bonding section has an annular cross-section and has an inner space that allows at least the conductor tip to be inserted thereinto; the pressure-bonding section having the annular cross-section includes a sealing portion on a tip side thereof in which portions, facing each other, of an inner surface of the pressure-bonding section are in close contact with each other and which seals the pressure-bonding section; and the sealing portion has a concaved-shaped cross-section.

The width direction is generally perpendicular to a longitudinal direction which is the same as a longitudinal direction of the insulated wire to be connected to the pressure-bonding section by pressure-bonding. The cross-section having an annular shape or the like is a cross-section taken along a plane perpendicular to the longitudinal direction, namely, taken along a plane in the width direction.

The concaved-shaped cross-section may be generally U-shaped, generally elliptical, generally semi-circular, generally V-shaped or W-shaped with angled corners when seen in the front side.

According to the present invention, the water-blocking performance can be maintained for a long time in the state where the insulated wire is pressure-bonded.

This will be described in more detail. The pressure-bonding section has an annular cross-section and has an inner space that allows at least the conductor tip to be inserted thereinto. The pressure-bonding section having the annular cross-section includes a sealing portion on a tip side thereof in which portions, facing each other, of an inner surface of the pressure-bonding section are in close contact with each other and which seals the pressure-bonding section. Owing to this, the pressure-bonding section having an annular cross-section provides water-blocking performance with certainty.

However, in the case where the sealing portion is formed by deforming a portion on the tip side of the pressure-bonding section such that the portion is flat in the width direction to such a degree that the portions, facing each other, of an inner surface of the pressure-bonding section are in close contact with each other, the cross-sectional coefficient of the sealing portion is smaller than that of the rest of the crimp terminal. In this case, the strength of the sealing portion formed to provide the water-blocking performance is lowered, and the sealing portion may be bent in the middle. According to the present invention, the sealing portion is formed to have a concaved-shaped cross-section that is wide in the width direction. Owing to this, the cross-sectional coefficient of the sealing portion is increased and thus the crimp terminal has a sufficient strength with certainty.

As a result, the pressure-bonding section can prevent water from entering from the tip side thereof, and also is strong and thus is not bent in the middle. Therefore, the water-blocking performance can be maintained for a long time in the state where the insulated wire is pressure-bonded.

In an embodiment of the present invention, the sealing portion may be welded in a width direction such that the portions of the inner surface are fixed to each other.

According to the present invention, the water-blocking performance of the sealing portion can be improved.

There is no limitation on the method for welding the sealing portion such that the portions of the inner surface are fixed to each other. In the case where the welding is performed by use of laser, particularly, fiber laser, stability and high reliability are provided.

In an embodiment of the present invention, the conductor may be formed of an aluminum-based material, and at least the pressure-bonding section may be formed of a copper-based material.

According to the present invention, the insulated wire can be more lightweight than an insulated wire including a conductor formed of copper, and so-called galvanic corrosion can be prevented.

This will be described in more detail. In the case where the conductor of the insulated wire is formed of an aluminum-based material such as aluminum, an aluminum alloy or the like instead of a copper-based material conventionally used, and the conductor formed of such an aluminum-based material is pressure-bonded to the crimp terminal, the following problem Occurs. The phenomenon that the aluminum-based material, which is a less noble metal material is corroded by contact with the terminal plated with a nobler metal material such as tin, gold or the like or formed of a copper alloy or the like occurs; namely, galvanic corrosion occurs.

Galvanic corrosion is a phenomenon that when moisture is attached to a contact part where a nobler metal material and a less noble metal material contact each other, a corrosion electric current is generated and the less noble metal material is corroded, melt, eliminated or the like. When this phenomenon occurs, the conductor formed of an aluminum-based material and pressure-bonded to the pressure-bonding section of the crimp terminal is corroded, melt or eliminated, which leads to increase in electric resistance. This causes a problem that a sufficient conducting function is not provided.

When the pressure-bonding is performed with the desirable shape as described above, the insulated wire is made more lightweight than an insulated wire including a conductor formed of a copper-based material, while being protected against so-called galvanic corrosion.

As a result, a connection state having stable conductivity with certainty is provided regardless of the types of metal used to form the crimp terminal and the conductor of the insulated wire.

The pressure-bonding section may be formed of, for example, a copper-based material such as copper, a copper alloy or the like. The conductor may be formed of, for example, aluminum raw wires, aluminum alloy raw wires or the like.

The present invention is also directed to a connection structural body, including the insulated wire and the above-described crimp terminal, which are connected to each other by the pressure-bonding section of the crimp terminal.

According to the present invention, a connection state having stable conductivity with certainty is provided.

The present invention is also directed to a wire harness, including a plurality of the above-described connection structural bodies bound together.

According to the present invention, the wire harness has stable conductivity with certainty regardless of the types of metal used to form the crimp terminal and the conductor.

The present invention is also directed to a connector, including the crimp terminal in the above-described connection structural body, the crimp terminal being located in a connector housing.

According to the present invention, a connection state having stable conductivity with certainty is provided.

Advantageous Effects of Invention

The present invention provides a crimp terminal capable of maintaining a high level of water-blocking performance for a long time in the state of being pressure-bonded to an insulated wire, a connection structural body including the same, and a connector including such a connection structural body.

BRIEF DESCRIPTION OF DRAWINGS

FIGS. **1**(*a*) to **1**(*c*) shows a method for pressure-bonding a pressure-bonding section of a female crimp terminal to an insulated wire.

FIGS. **2**(*a*) to **2**(*c*) shows a method for forming a concaved sealing portion on a tip side of the pressure-bonding section.

FIG. **3** is a cross-sectional view of the female crimp terminal in a post-pressure-bonding state taken along a plane extending in a longitudinal direction thereof along a center of a width direction thereof.

FIG. **4** shows connectors.

FIGS. **5**(*a*) to **5**(*h*) shows concaved sealing portions in other embodiments.

FIGS. **6**(*a*) to **6**(*c*) shows another welding method usable for the pressure-bonding section.

DESCRIPTION OF EMBODIMENTS

Hereinafter, an embodiment of the present invention will be described with reference to the drawings.

FIGS. **1**(*a*) to **1**(*c*) shows a method for pressure-bonding a pressure-bonding section **30** of a female crimp terminal **10** to an insulated wire **200**. In more detail, FIG. **1**(*a*) is a cross-sectional view of the female crimp terminal **10** in a pre-pressure-bonding state taken along a plane extending in a longitudinal direction thereof along a center of a width direction thereof. FIG. **1**(*b*) is an isometric view of the female crimp terminal **10** and the insulated wire **200** in the pre-pressure-bonding state. FIG. **1**(*c*) is an isometric view of a pressure-bonding connection structural body **1**.

FIGS. **2**(*a*) to **2**(*c*) shows a method for forming a concaved sealing portion **34** on a tip side of the pressure-bonding section **30**. In more detail, FIG. **2**(*a*) is an isometric view of the female crimp terminal **10** in which the pressure-bonding section **30** includes a flat sealing portion **34'** on the tip side thereof. The flat sealing portion **34'** is formed as a result of pressure-bonding. FIG. **2**(*b*) is an enlarged view of part "a" of FIG. **2**(*a*) showing the flat sealing portion **34'**. FIG. **2**(*c*) is an enlarged view of the concaved sealing portion **34**. FIG. **3** is a cross-sectional view of the female crimp terminal **10** in a post-pressure-bonding state taken along a plane extending in a longitudinal direction thereof along a center of a width direction thereof.

The pressure-bonding connection structural body **1** in this embodiment includes the female crimp terminal **10** and the insulated wire **200** connected to the female crimp terminal **10**. More specifically, a conductor tip **201***a* of an aluminum core wire **201** that is exposed from an insulating tip **202***a* of an insulating cover **202** of the insulated wire **200** is connected by pressure-bonding to the pressure-bonding section **30** of the female crimp terminal **10**. Thus, the pressure-bonding connection structural body **1** is formed.

The insulated wire **200** connected to the female crimp terminal **10** by pressure-bonding includes the aluminum core wire **201** which includes a bundle of aluminum raw wires, and the insulating cover **202** formed of an insulating resin. The aluminum core wire **201** is covered with the insulating cover **202**. In more detail, the aluminum core wire **201** is formed by twisting aluminum alloy wires so as to have a cross-sectional area having an area size of 0.75 mm^2.

The female crimp terminal **10** includes a box section **20** that allows an insertion tab of a male connector (not shown) to be inserted thereinto, and the pressure-bonding section **30** located rear to the box section **20**. The box section **20** is located on a tip side or a front side of the female crimp terminal **10** in a longitudinal direction X. The box section **20** and the pressure-bonding section **30** are formed integrally while having a transition section **20***a* having a predetermined length being provided therebetween.

The longitudinal direction X matches a longitudinal direction of the insulated wire **200** connected to the pressure-bonding section **20** as a result of pressure-bonding the pressure-bonding section **30**.

The female crimp terminal **10** is formed of a copper alloy strip (not shown) such as a brass strip or the like having a tin-plated (Sn-plated) surface. The female crimp terminal **10** is a closed-barrel-shaped terminal including the box section **20** and the pressure-bonding section **30**. The box section **20** is provided on the front side in the longitudinal direction X and has a hollow quadrangular prism shape. The pressure-bonding section **30** is provided on the rear side in the longitudinal direction X and has an annular cross-section.

A male crimp terminal (not shown) includes a pressure-bonding section having an insertion tab, which is inserted into a box section. Such a male crimp terminal has substantially the same structure (see FIGS. **1**(*a*) to **1**(*c*) and FIG. **3**).

The box section **20** having the hollow quadrangular prism shape has an elastic contact piece **21** in a front part of an inner space thereof. The elastic contact piece **21** is folded rearward in the longitudinal direction X and contacts the insertion tab (not shown) of the male connector which is inserted into the box section **20**.

The box section **20** includes a bottom portion **22** and side portions **23***a* and **23***b*. The side portions **23***a* and **23***b* are provided along, and continuous from, two sides of the bottom portion **22** in a Y direction perpendicular to the longitudinal direction X, and are folded up from the bottom portion **22**. As seen from the front side in the longitudinal direction X, the box section **20** is generally rectangular.

In the pre-pressure-bonding state, the pressure-bonding section **30** includes a pressure-bonding bottom portion **31** and a barrel piece **32** provided along, and continuous from, two sides of the pressure-bonding bottom portion **31** in the Y direction perpendicular to the longitudinal direction X. As seen from the rear side in the longitudinal direction X, the pressure-bonding section **30** is generally annular (see FIGS. **1**(*a*) and (*b*)). The pressure-bonding section **30** has an inner space that allows the conductor tip **201***a* of the aluminum core wire **201** to be inserted thereinto.

A length Xb (see FIGS. **1**(*b*) and **1**(*c*)), in the longitudinal direction X, of the pressure-bonding section **30** is longer than a length Xw, in the longitudinal direction X, of the conductor tip **201***a* exposed forward from the insulating tip **202***a*, which is a front tip of the insulating cover **202** in the longitudinal direction X.

The pressure-bonding section **30** includes a wire pressure-bonding section **30***a* that pressure-bonds the conductor tip **201***a* of the aluminum core wire **201**, and a cover pressure-bonding section **30***b* that pressure-bonds the insulating cover **202**. The wire pressure-bonding section **30***a* and the cover pressure-bonding section **30***b* are formed integrally. An inner circumferential area of the pressure-bonding section **30** has a circumferential length and a shape conformed to an outer diameter of the insulating cover **202**.

An inner surface of the wire pressure-bonding section **30***a* has three serrations **33** at a predetermined distance therebetween in the longitudinal direction X. The serrations **33** are grooves extending in the width direction Y. The aluminum core wire **201** penetrates into the serrations **33** in the state of being pressure-bonded.

The serrations **33** are continuous from the pressure-bonding bottom portion **31** to the barrel pieces **32** in the width direction Y.

The pressure-bonding section **30** includes a concaved sealing portion **34**, in which portions of an inner surface of the pressure-bonding section **30** are in close contact with each other. As seen from the front side in the longitudinal direction X, the concaved sealing portion **34** has a generally U-shaped cross-section which is wide in the width direction Y.

The concaved sealing portion **34** is formed as follows.

First, a portion on the tip side of the pressure-bonding section **30** that protrudes forward from a tip **201***aa* of the conductor tip **201***a* is deformed to be flat and wide in the width direction Y. As a result, the flat sealing portion **34'** deformed to be flat as seen from the front side in the longitudinal direction X is formed.

This will be described in more detail. The portion on the tip side of the pressure-bonding section **30** that protrudes forward from the tip **201***aa* of the conductor tip **201***a* is deformed such that an inner surface of the pressure-bonding bottom portion **31** and an inner surface of the barrel piece **32** facing each other are put into close contact with each other. As a result, the flat sealing portion **34'** is formed on the tip side of the pressure-bonding section **30** (see FIGS. **2**(*a*) and (*b*)).

After thus being formed, the flat sealing portion **34'** is subjected to laser welding performed in the width direction to improve the water-blocking performance. Preferably, the laser welding is performed by use of fiber laser.

After the flat sealing portion **34'** is welded by laser, the flat sealing portion **34'** is pressurized by use of a member such as a crimper jig or the like (not shown) to be deformed to have a generally U-shaped cross-section. As a result, the concaved sealing portion **34** having a generally U-shaped cross-section which is wide in the wide direction Y as seen in the front side in the longitudinal direction X is formed. The concaved sealing portion **34** has a concaved portion **34***a* at an inner center part thereof (see FIG. **2**(*c*) and FIG. **3**).

In this manner, the portion on the tip side of the pressure-bonding section **30** is deformed to be flat to form the flat sealing portion **34'**, and then the flat sealing portion **34'** is deformed to have a generally U-shaped cross-section to form the concaved sealing portion **34**. Thus, the pressure-bonding section **30** is assured to provide the water-blocking performance on the tip side.

The concaved sealing portion **34** having a generally U-shaped cross-section as a result of deformation is provided on the tip side of the pressure-bonding section **30**. In this case, as compared with the case where a sealing portion which is merely flat and wide in the width direction Y is formed by pressure-bonding, the cross-sectional coefficient is higher and thus the female crimp terminal **10** is assured to have a sufficient strength.

Therefore, the concaved sealing portion **34** can prevent water from entering the pressure-bonding section **30** from the tip side thereof, and also is strong and thus is not bent in the middle.

Now, the pressure-bonding connection structural body **1** including the crimp terminal **10** and the insulated wire **200** connected to the female crimp terminal **10** will be described. In the pressure-bonding connection structural body **1**, the aluminum core wire **201** of the insulated wire **200** is pressure-bonded to the pressure-bonding section **30** of the female crimp terminal **10** (see FIGS. **1**(*a*) to **1**(*c*) through FIG. **3**).

This will be described in more detail. The insulated wire **200** is located in the pressure-bonding section **30** such that the tip **201***aa* of the conductor tip **201***a* of the aluminum core wire **201** that is exposed forward from the insulating cover **202** of the insulated wire **200** is located rear to the tip side of the pressure-bonding section **30** in the longitudinal direction X (front tip of the barrel piece **32**).

Then, as shown in FIG. **1**(*c*), the conductor tip **201***a* from the tip **201***aa* to a position rear to the insulating tip **202***a* of the insulating cover **202** is integrally pressure-bonded and enclosed by the pressure-bonding section **30**.

After the insulated wire **200** is located in the pressure-bonding section **30**, the entirety of the pressure-bonding section **30** is pressurized by use of, for example, a member such as a crimper jig or the like (not shown) to be deformed such that the diameter of the pressure-bonding section **30** is reduced and the pressure-bonding section **30** covers the insulating cover **202** of the insulated wire **200** and the conductor tip **201***a* of the aluminum core wire **201**. Thus, the pressure-bonding section **30** and the aluminum core wire **201** are connected to each other by pressure-bonding.

In the pressure-bonding connection structural body **1** having such a structure, the pressure-bonding section **30** is completely sealed on the tip side by the concaved sealing portion **34** such that the aluminum core wire **201** of the insulated wire **200** is not exposed outside. Therefore, after the pressure-bonding, water is prevented from entering the inside of the pressure-bonding section **30** from the tip side thereof. Thus, galvanic corrosion, which would be caused by moisture attaching a contact part where the female crimp terminal **10** formed of copper or a copper alloy that is a nobler metal material and the aluminum core wire **201** formed of aluminum or an aluminum alloy that is a less noble metal material are connected each other, is prevented.

Therefore, corrosion of the surface of the aluminum core wire **201**, which would reduce the conductivity between the female crimp terminal **10** and the aluminum core wire **201**, is prevented, and thus the water-blocking state can be maintained for a long time. Thus, high reliability is provided.

Namely, since the insulated wire is pressure-bonded with a desirable shape as described above, the insulated wire can include a conductor more lightweight than a conductor formed of a copper-based material while being protected against corrosion.

As a result, the pressure-bonding connection structural body **1** assured to have stable conductivity in a connected state can be provided regardless of the types of metal used to form the crimp terminal **10** and the conductor of the insulated wire **200**.

Now, with reference to FIG. **4**, an example in which a pressure-bonding connection structural body **1***a* including the above-described female crimp terminal **10** and a pressure-bonding connection structural body **1***b* including a male crimp terminal (not shown) are respectively connected to a pair of connector housings **300** will be described.

The pressure-bonding connection structural body **1***a* is a connection structural body including the female crimp terminal **10**, and the pressure-bonding connection structural body **1***b* is a connection structural body including the male crimp terminal.

By connecting the pressure-bonding connection structural bodies **1** (**1***a*, **1***b*) to the connector housings **300** respectively, a female connector **3***a* and a male connector **3***b* having conductivity with certainty can be provided.

In the following example, both of the female connector **3***a* and the male connector **3***b* are connectors of wire harnesses **301** (**301***a*, **301***b*). Alternatively, one of the female connector **3***a* and the male connector **3***b* may be a connector of a wire harness whereas the other of the female connector **3***a* and the male connector **3***b* may be a connector of an assisting element such as a substrate, a component or the like.

This will be described in more detail. As shown in FIG. **4**, the pressure-bonding connection structural body **1***a* including the female crimp terminal **10** is attached to the female connector housing **300** to form the wire harness **301***a* including the female connector **3***a*.

The pressure-bonding connection structural body **1***b* including the male crimp terminal is attached to the male connector housing **300** to form the wire harness **301***b* including the male connector **3***b*.

By putting the female connector **3***a* and the male connector **3***b* each having the above-described structure into engagement with each other, the wire harness **301***a* and the wire harness **300***b* are connected to each other.

The connector housings **300** have the pressure-bonding connection structural bodies **1** attached thereto. Therefore, the wire harnesses **301** can be connected to each other while having conductivity with certainty.

Specifically, the female crimp terminal **10** of the pressure-bonding connection structural body **1***a* and the male crimp terminal of the pressure-bonding connection structural body **1***b* each have a sealing structure in which the conductor tip **201***a* of the aluminum core wire **201** of the insulated wire **200** is integrally covered with the pressure-bonding section **30** and is not exposed outside.

Therefore, even when the female crimp terminals are exposed to the air in the connector housing **300**, galvanic corrosion, which would reduce the conductivity, is not caused. Thus, the electric connection between the aluminum core wire **201** located in the pressure-bonding section **30** and, for example, the crimp terminal **10** can be maintained. A connection state having conductivity with certainty is provided.

The conductor according to the present invention corresponds to the aluminum core wire **201** in the embodiment; and similarly,

the connection structural body corresponds to the pressure-bonding connection structural body **1** or **1***a;*

the crimp terminal corresponds to the female crimp terminal **10**;

the sealing portion corresponds to the flat sealing portion **34'** or the concaved sealing portion **34**; and the connector corresponds to the female connector **3**a or the male connector **3**b.

However, the present invention is not limited to the above-described embodiment, and may be applied based on the technological idea of the claims and may be carried out in any of various forms.

For instance, in the above embodiment, the pressure-bonding section of the crimp terminal is connected by pressure-bonding to a wire conductor formed of a less noble metal material such as aluminum, an aluminum alloy or the like. Alternatively, the pressure-bonding section may be connected by pressure-bonding to a wire conductor formed of a nobler metal material such as copper, a copper alloy or the like. In this case also, substantially the same functions and effects as those of the above-described embodiment are provided.

This will be described in more detail. The pressure-bonding section **30** described above can prevent water from entering in the pressure-bonded state. Therefore, the pressure-bonding section **30** can be connected to an insulated wire including a core wire formed of, for example, copper, a copper alloy or the like, which conventionally needs to be sealed after being pressure-bonded in order to have an inter-wire water blocking function.

FIGS. **5**(a) to **5**(h) shows concaved sealing portions **35** in other embodiments. The cross-section of the concaved sealing portion does not need to be U-shaped as in the case of the concaved sealing portion **34** or generally elliptical, and may be, for example, generally semi-circular, generally V-shaped, generally W-shaped, generally U-shaped with angled corners, or of any of various other shapes as in the case of the concaved sealing portions **35** shown in FIGS. **5**(a) to **5**(h). Alternatively, such shapes may be inverted upside down.

This will be described more specifically. As shown in FIG. **5**(a), the sealing portion may be a concaved sealing portion **35**a having strongly pressure-bonded portions **35**aa. The pressure-bonded portions **35**aa are formed by strongly pressure-bonding, in an up-down direction, areas in the vicinity of both sides of the pressure-bonded portions **35**a in the width direction Y. As shown in FIG. **5**(b), the sealing portion may be a concaved sealing portion **35**b having protrusions **35**ba at both sides thereof in the width direction Y. The protrusions **35**ba protrude upward and downward, so that the concaved sealing portion **35**b is generally T-shaped on each side as seen in a plan view. As shown in FIG. **5**(c), the sealing portion may be a concaved sealing portion **35**c having protrusions **35**ca at both sides thereof in the width direction Y. The protrusions **35**ca protrude obliquely upward and obliquely downward, so that the concaved sealing portion **35**c is generally Y-shaped on each side as seen in a plan view. As shown in FIG. **5**(d), the sealing portion may be a concaved sealing portion **35**d having protrusions **35**da at both sides thereof in the width direction Y. The protrusions **35**da protrude upward, so that the concaved sealing portion **35**d is generally L-shaped on each side as seen in a plan view.

As shown in FIG. **5**(e), the sealing portion may be a concaved sealing portion **35**e having bent portions **35**ea. The bent portions **35**ea are formed by shifting, in the up-down direction, areas in the vicinity of both sides of the pressure-bonded portions **35**e in the width direction Y. The bent portions **35**ea are parallel to the rest of the concaved sealing portion **35**e. As shown in FIG. **5**(f), the sealing portion may be a concaved sealing portion **35**f which is generally W-shaped.

As shown in FIG. **5**(g), the sealing portion may be a concaved sealing portion **35**g in which left and right portions of the barrel piece **32** overlap the pressure-bonding bottom portion **31**. The overlapping portions may have any of various shapes as described above.

As shown in FIG. **5**(h), the sealing portion may be a concaved sealing portion **35**h obtained by inverting the concaved sealing portion **34** upside down. The concaved sealing portion **35**h has an inverted U-shaped cross-section protruding upward. Similarly, the concaved sealing portions **35** (**35**a through **35**g) may be inverted upside down.

Regardless of whether the concaved sealing portions (**35**a through **35**h) are inverted upside down or not, substantially the same effects as those provided by the concaved sealing portion **34** are provided.

The female crimp terminal **10** does not need to have the box section **20**, and may include only the pressure-bonding section **30** including the concaved sealing portion **34**.

In the above-described description, the flat sealing portion **34'** is subjected to laser welding performed in the width direction and then deformed to have a U-shaped cross-section to provide the concaved sealing portion **34**. Alternatively, the flat sealing portion **34'** may be deformed to have a U-shaped cross-section and then subjected to laser welding.

In the above-described description, the portion on the tip side of the pressure-bonding section **30** is deformed to be flat and wide in the width direction Y as seen in the front side in the longitudinal direction X to form the flat sealing portion **34'**, and then the flat sealing portion **34'** is deformed to have a generally U-shaped cross-section to form the concaved sealing portion **34**. Alternatively, the inner surface of the pressure-bonding bottom portion **31** and the inner surface of the barrel piece **32** may be put into close contact with each other while being deformed at the same time such that the pressure-bonded portion have a generally U-shaped cross-section to form the concaved sealing portion **34**.

A part of, or the entirety of, the transition section **20**a located rear to the box section **20** may be continued with the concaved sealing portion **34** so as to have a generally U-shaped cross-section. Alternatively, only the transition section **20**a may be deformed to have a generally U-shaped cross-section.

According to an embodiment, the pressure-bonding section **30** is formed as follows. A copper strip punched out to have the shape of the terminal is rolled such that ends of the rolled copper strip facing each other are joined together. The ends are welded along a welding line defined in the longitudinal direction X to be generally O-shaped as seen from the rear side. Then, a front tip portion thereof in the longitudinal direction X is deformed and welded for sealing along a welding line defined in the width direction Y. The pressure-bonding section **30** formed in this manner has a generally cylindrical shape, is sealed by the sealing portion at the front end in the longitudinal direction X, and is opened rearward in the longitudinal direction X. FIGS. **6**(a) to **6**(c) shows another welding method usable for the pressure-bonding section **30**. As shown in FIGS. **6**(a) to **6**(c), the copper strip may be formed into the shape of the pressure-bonding section **30** and then welded along the welding line to form the pressure-bonding section **30**.

This will be described in more detail. As shown in FIG. **6**(a), a copper strip punched out to have the shape of the terminal is rolled, and the front portion in the longitudinal direction X is deformed, so that the shape of the pressure-bonding section **30** including the sealing portion is provided. Then, ends facing each other of the copper strip thus shaped are joined together along a welding line W3 defined in the longitudinal direction X, and the sealed portion is welded along a line W4 defined in the width direction Y. Thus, the pressure-bonding section **30** is formed.

The ends facing each other may be welded on the bottom side of the pressure-bonding section **30**. Alternatively, as shown in FIGS. **6**(*a*) and (*b*), the ends facing each other may be welded on the top side of the pressure-bonding section **30**.

Still alternatively, as shown in FIG. **6**(*c*), in the pressure-bonded state, the cover pressure-bonding section **30***b* of the pressure-bonding section **30** may be pressure-bonded to the insulating cover **202** of the insulated wire **200** such that the cover pressure-bonding section **30***b* is annular as seen from the front side, and the wire pressure-bonding section **30***a* may be pressure-bonded to the aluminum core wire **201** such that the wire pressure-bonding section **30***a* is U-shaped as seen from the front side.

In the method shown in FIGS. **6**(*a*) to **6**(*c*), while the pressure-bonding section **30** is attached to a strip-like carrier K, the pressure-bonding section **30** is subjected to the welding. The pressure-bonding section **30** may be detached from the carrier K at the time when the insulated wire **200** is connected by pressure-bonding to the pressure-bonding section **30** or after the insulated wire **200** is connected thereto. Alternatively, the female crimp terminal **10** may be formed in the state of being separated from the carrier K, and the insulated wire **200** may be connected thereto by pressure-bonding.

REFERENCE SIGNS LIST

1, **1***a* . . . Pressure-bonding connection structural body
3*a* . . . Female connector
3*b* . . . Male connector
10 . . . Female crimp terminal
30 . . . Pressure-bonding section
31 . . . Pressure-bonding bottom portion
32 . . . Barrel piece
34, **35** . . . Concaved sealing portion
34*a* . . . Concaved portion
200 . . . Insulated wire
201 . . . Aluminum core wire
201*a* . . . Conductor tip
202 . . . Insulating cover
202*a* . . . Insulating tip
300 . . . Connector housing
X . . . Longitudinal direction
Y . . . Width direction

The invention claimed is:

1. A crimp terminal, comprising:

a connection section connectable with a connection section of another terminal; and

a pressure-bonding section, adjacent to the connection section, that allows at least a conductor tip of a conductor of an insulated wire extending in a longitudinal direction to be connected thereto by pressure-bonding, the conductor being covered with an insulating cover, and the conductor tip being exposed as a result of removing the insulating cover, wherein:

the pressure-bonding section includes an annular cross-section and includes an inner space that allows at least the conductor tip to be inserted thereinto,

a distal end of the pressure-bonding section adjacent to the connection section is deformed such that inner surfaces of the distal end are in close contact with each other to seal the pressure-bonding section at a sealing portion, and the distal end includes a concaved-shaped cross-section,

the distal end is deformed such that a center area of the distal end in a width direction with respect to the longitudinal direction when the inner surfaces of the distal end are in close contact with each other is shifted to either upward or downward to form an arc shape when viewed from the longitudinal direction, so that the sealing portion is curved in the arc shape along the width direction,

a welded portion that extends in the width direction is formed in the sealing portion along the arc shape,

the distal end is provided between the conductor tip and the connection section, and

a plurality of serrations are provided on an inner surface of the pressure-bonding section.

2. The crimp terminal according to claim **1**, wherein the distal end is welded in the width direction such that the inner surfaces of the distal end are fixed to each other.

3. The crimp terminal according to claim **1**, wherein the conductor is formed of an aluminum-based material, and at least the pressure-bonding section is formed of a copper-based material.

4. A connection structural body, comprising the insulated wire and the crimp terminal according to claim **1**, which are connected to each other by the pressure-bonding section of the crimp terminal.

5. A wire harness, comprising a plurality of the connection structural body according to claim **4** bound together.

6. A connector, comprising the crimp terminal in the connection structural body according to claim **4**, the crimp terminal being located in a connector housing.

7. The crimp terminal according to claim **1**, wherein the distal end includes the concaved-shaped cross-section in an entirety of the longitudinal direction of the distal end.

8. The crimp terminal according to claim **1**, wherein the connection section and the pressure-bonding section are formed integrally.

9. The crimp terminal according to claim **8**, wherein a transition section is provided between the connection section and the pressure-bonding section.

10. The crimp terminal according to claim **1**, wherein the plurality of serrations are grooves extending in the width direction.

11. The crimp terminal according to claim **1**, wherein the plurality of serrations are provided on the inner surface of the pressure-bonding section at a predetermined distance therebetween in the longitudinal direction.

12. The crimp terminal according to claim **1**, wherein

a joined portion at which ends of the crimp terminal are welded and joined together is formed as a welded portion extending in the longitudinal direction to form the pressure-bonding section as tube-shaped with the annular cross-section, and

in the sealing portion, the welded portion extending in the longitudinal direction and the welded portion that extends in the width direction cross each other.

13. A crimp terminal, comprising:

a connection section connectable with a connection section of another terminal; and

a pressure-bonding section, adjacent to the connection section, that allows at least a conductor tip of a conductor of an insulated wire extending in a longitudinal direction to be connected thereto by pressure-bonding, the conductor being covered with an insulating cover, and the conductor tip being exposed as a result of removing the insulating cover, wherein:

a joined portion at which ends of the crimp terminal are welded and joined together is formed as a welded portion extending in the longitudinal direction to form the pressure-bonding section as tube-shaped with an annular cross-section,

the pressure-bonding section includes an inner space that allows at least the conductor tip to be inserted thereinto,

a distal end of the pressure-bonding section adjacent to the connection section is deformed such that inner surfaces of the distal end are in close contact with each other to seal the pressure-bonding section at a sealing portion, and the distal end includes a concaved-shaped cross-section,

the distal end is deformed such that a center area of the distal end in a width direction with respect to the longitudinal direction when the inner surfaces of the distal end are in close contact with each other is shifted to either upward or downward to form an arc shape when viewed from the longitudinal direction, so that the sealing portion is curved in the arc shape, in a vertical plane, with respect to the welded portion extending in the longitudinal direction,

the distal end is provided between the conductor tip and the connection section, and

a plurality of serrations are provided on an inner surface of the pressure-bonding section.

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